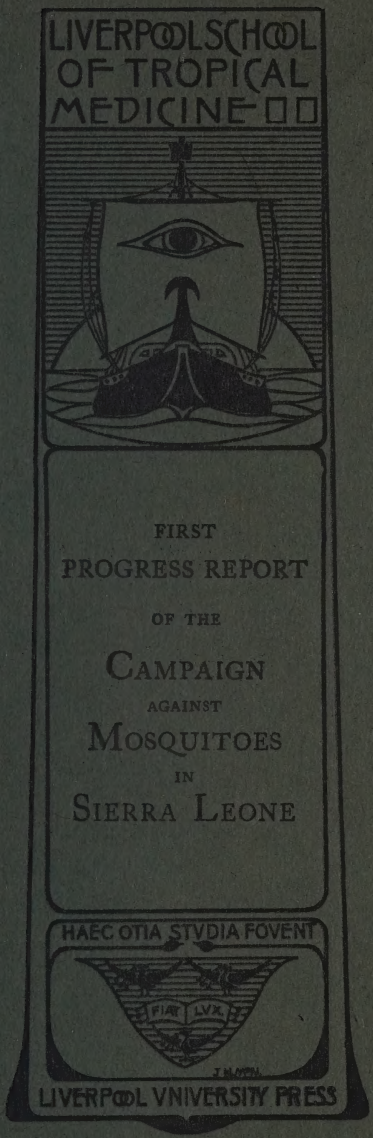

FIRST PROGRESS REPORT OF THE CAMPAIGN AGAINST MOSQUITOES IN SIERRA LEONE

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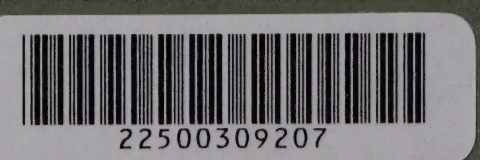

LIVERPOOL SCHOOL OF TROPICAL MEDICINE

MEMOIR V. PART I

FIRST PROGRESS REPORT

OF THE

CAMPAIGN AGAINST MOSQUITOES

IN SIERRA LEONE

BY

RONALD ROSS, F.R.C.S., D.P.H., F.R.S.

WALTER MYERS LECTURER

LIVERPOOL SCHOOL OF TROPICAL MEDICINE

Dated Liverpool, 15th October, 1901

AT THE UNIVERSITY PRESS OF LIVERPOOL 1901

REPORT

Dated Liverpool, 15th October, 1901

Preliminary

THIS enterprise was undertaken in the following circumstances:—Shortly after the development of the parasites of malaria in mosquitoes had been determined by my researches of 1895-98, I suggested that the proper way to extirpate malaria in towns and cantonments would be to drain the breeding places of the insects which carry the disease.* All efforts to induce the authorities to adopt this idea remained, however, almost entirely unavailing during two years;† and at last I resolved upon starting the work by the help of private enterprise. On the 1st May, 1901, I received from a gentleman with whom I have the honour to be acquainted the sum of one thousand pounds with which to commence the work; and this amount he has since doubled. The project was adopted with energy by the Liverpool School of Tropical

* Letter to Government of India, 16th February, 1899, partly published in *Indian Medical Gazette*, July, 1899; also *British Medical Journal*, 1st July, 1899; also *Lancet*, 1900, vol. ii, page 1400; also *Journal of the Society of Arts*, 30th November, 1900.

† The admirable measures instituted against malaria in Lagos by Sir W. MacGregor and Dr. Strachan are conducted largely on different lines; and the operations of Young and Thomson in Hong Kong, and of others elsewhere, have been very limited in area. I shall presently refer to the work in Havana.

Medicine; and supplementary gifts and assistance of all kinds were given by Alfred L. Jones, Esq., J.P., John Holt, Esq., F. Swanzy, Esq., Professor Boyce, Max Muspratt, Esq., Dr. Kohn, and other gentlemen. Mr. Logan Taylor, M.B., B.S., of the Pathological Laboratory of Glasgow University, was appointed to superintend the operations; and Freetown, Sierra Leone, was selected to be the site of the experiment, partly because its malaria had been already surveyed by the scientific expeditions of the Liverpool School of Tropical Medicine and the Royal Society, and partly because the place is so difficult to deal with on account of the heavy rainfall and the nature of the soil that it affords a fair, and, indeed, somewhat severe test, of the feasibility of the measures recommended by me. As showing the popular interest in the matter, I may mention that the expedition was entertained by Mr. Alfred L. Jones at a valedictory banquet, which was honoured by the presence of the Lord Mayor of Liverpool, the Lord Bishop of Liverpool, the Director General of the Indian Medical Service (Surgeon-General Harvey, D.S.O., C.B.), the President of the Royal Institute of Public Health (W. R. Smith, Esq., M.D., F.R.S.E.), and other distinguished guests. The Right Honourable Mr. Joseph Chamberlain, H.M. Secretary of State for the Colonies, signified his approval and support of the scheme, and the expedition left England on the 15th of June.

Commencement of Campaign

We arrived at Freetown* on the 2nd of July, and were very hospitably entertained by His Excellency the Governor, Sir Charles King Harman, K.C.M.G. At

* Freetown contains 30,000 inhabitants.

a public lecture, at which His Excellency presided, a resolution in support of our efforts was unanimously adopted.

Dr. Logan Taylor commenced work without delay. In my first suggestions for controlling malaria I had recommended measures against mosquitoes of the genus *Anopheles* only ; but mosquitoes of the genus *Stegomyia* have now been conclusively proved to carry yellow fever ; and mosquitoes of the genus *Culex* have long been known to carry *Filaria nocturna* (elephantiasis). Malaria and elephantiasis prevail all down the coast; and many medical men of repute consider that yellow fever also has existed there from time to time. In addition, it is beginning to be thought by some that mosquitoes may carry other diseases, especially various tropical fevers distinct from malaria and typhoid ; and, altogether apart from their pathological agency, most kinds of mosquitoes undoubtedly cause an immense amount of annoyance in the tropics, and, next to the heat, constitute perhaps the principal drawback of life in warm climates. We determined, therefore, to push our campaign against all kinds of mosquitoes indiscriminately.

Dr. Taylor immediately engaged the services of over twenty men, under intelligent head men. To these His Excellency the Governor added twelve men, and gave the necessary carts and implements. This force was divided into two gangs ; a small gang of six men (called the *Culex* gang), to collect from private houses all the broken bottles and buckets, empty tins, old calabashes, and similar unconsidered vessels in which mosquitoes of the genera *Stegomyia* and *Culex* breed ; and a larger gang (called the *Anopheles* gang), to drain the pools and puddles in the streets and the backyards of the houses, in which *Anopheles* breed.

The *Culex* gang, under a native headman, did very rapid work. They piled the rubbish into carts, which then discharged it into an assigned rubbish shoot. At the same time they showed the larvae to occupants of houses and instructed them in the manner of destroying them by emptying the vessels which contain them, or by dropping a little oil on the surface of water in which they live. It was found that on the average this gang cleared about fifty houses, and removed about ten cart-loads of empty tins and broken bottles daily. The effect of this work on the prevalence of *Culex* and *Stegomyia* can be imagined when it is remembered that about one-third of the tins and bottles contained the larvae at this season (the rains). Every house had previously been breeding mosquitoes in its own backyard or garden. The occupants welcomed the gang where-ever it went, and some stated that they had not been able to get rid of their rubbish for years.

The *Anopheles* gang had a more difficult task. The breeding-pools of these insects in Freetown, both in the rains and the dry weather, have been minutely described by two previous scientific expeditions.* At this season the water courses contained impetuous torrents too rapid for larvae to live in; but the streets, yards, and gardens possessed numerous pools of rain-water, well suited for them. These were attacked by many methods. Some were filled with earth, rubble, and turf. Others were evacuated by cutting through the rock which contained them, or by making channels in the soft earth. Owing to the large rainfall (estimated at about one hundred and sixty inches annually), to the

* Report of the Liverpool Malaria Expedition to Sierra Leone, University Press, Liverpool, 1900; and Reports of the Malaria Committee of the Royal Society, Harrison & Sons, St. Martin's Lane, London.

peculiar nature of the ground, and to the very defective surface drains, these puddles were exceptionally numerous in Freetown ; and, in order to drain many of them as soon as possible, it was deemed advisable to adopt the simplest and least expensive methods at first, and to reserve more permanent works for the future. At the same time several men were specially employed in brushing out with brooms, or treating with crude petroleum or creosote, those puddles which the workmen had not yet had time to touch. Progress was fairly rapid in spite of the deluge of rain ; and many of the worst streets were fairly well drained in a few weeks.*

On the 22nd of July, I left Sierra Leone in order to visit Lagos and the Gold Coast. A few days later Lieutenant McKendrick, M.B., of the Indian Medical Service arrived. The government of India, to whose well-advised action in 1898 so much is due, had determined, on the initiative of Surgeon-General Harvey, to send Lieutenant McKendrick to study our operations in Freetown. Dr. McKendrick remained there for a month.

I returned to Sierra Leone on the 16th August, and, after witnessing Dr. Taylor's excellent work, left after five days, in company with Dr. McKendrick for England, on private affairs. Shortly after my departure Dr. Daniels, Superintendent of the London School of Tropical Medicine (conveyed by the Liverpool School), arrived on the same errand as Lieutenant McKendrick. He also remained some weeks with Dr. Taylor, and studied his methods with great care. His report on the subject will be given at the end of this report.

In letters, dated the 17th and 28th September, Dr. Taylor says that progress has been satisfactory,

* The proper methods of dealing with mosquitoes are given in detail in my forthcoming work called *Mosquito Brigades, and How to Organize Them*; George Phillip & Son, 32, Fleet Street, London ; price three shillings.

although impeded by heavy rain. The *Culex* gang had cleared 6,500 houses up to the former date, and, I calculate, must have removed more than a thousant cart-loads of rubbish. The total number of workmen employed, including the twelve lent by the Governor, now number fifty-three. His Excellency has also given Dr. Taylor the assistance of Dr. Berkeley, of the Colonial Medical Service, who had previously done much useful work in Freetown in this connection. Major Smith, the able head of the Royal Army Medical Corps in Sierra Leone, is taking active steps to expel mosquitoes from the various military barracks. Drs. Daniels and Taylor have been able to inspect several places at a distance from Freetown, with a view to starting work there also. Two men are specially employed in keeping the centre of the town free from mosquitoes, while the *Culex* gang is working elsewhere ; but as this gang had cleared nine-tenths of the town up to the 28th September, it will now be able to commence at the centre again, and perfect its former work.

As the rains are now ceasing, the dry-weather operations will shortly begin. These will consist chiefly in attacking the drying water courses, in which *Anopheles* chiefly breed at that season. Dr. Taylor is already beginning the work from the 1st October, by filling hollows in rocks with concrete. These operations will be detailed in a future progress report. It is possible that a hundred or more men will have to be employed shortly.

Results up to the present

It is always very difficult to make an exact estimate of the number of mosquitoes anywhere, and, therefore, to gauge their increase or diminution with mathematical

certainty. For the present we must rely on a general consensus of opinion. Judging from this, the results are already most encouraging—indeed unexpectedly so. Lieut. McKendrick informs me that he was not conscious of having once been bitten by mosquitoes during his month's stay in Freetown. After the first week or so, I myself was never bitten, either at Government House* or at the house of the Expedition, in the centre of the town, though I am sure I should have been bitten several times a day in both, before the commencement of operations. Dr. Taylor writes on the 17th September, 'I think there is no doubt but that the number of mosquitoes (*Anopheles*) in the streets we have dealt with is diminishing; the people resident in the streets will tell you that at once; and the number of pots and tins that have been removed has made a considerable diminution in the *Culex*'—meaning also *Stegomyia*. On the 28th September, he writes, 'The mosquitoes are still on the decline, and in the streets we have been working in it is exceedingly difficult to find *Anopheles* now. Of course in the untouched parts they are still to be got. As for the *Culex* (or *Stegomyia*, to be correct) they have got a fright. They also are getting very scarce. The true *Culex* I seldom see; only now and again.' What this means in a tropical town only those who have resided in such can know.

The valuable testimony of Dr. Daniels to the same effect is given in his report at the end. All those who are familiar with his important work on malaria and other tropical diseases will know that he is one of the most cautious and trustworthy of observers.

Altogether I think that we have reason to be more than satisfied with the progress made.

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* Capt. Hodgins, A.D.C. to the Governor, had partially cleared Government House of larvae before our arrival.

Accounts

It might be imagined that all this work has been very expensive. On the contrary the expense has been slight. The whole cost of the expedition from its beginning, including cost of fitting out, salary of Dr. Taylor, wages of from twenty to forty workmen, and of eight hammock boys, rent and fitting of the house of the expedition, and other items, had amounted, at the end of September, that is for three and a half months, to only £304. This is exclusive of passages, oil, cement, and of the services of carts, and of twelve men lent by the governor. The wages of the workmen may be put roughly at about one pound a month each. Detailed accounts have been submitted to the School Committee and to the subscribers.

Other Expeditions

On passing Bathurst, and during my visit to the Gold Coast, I was able to arrange with Sir George Denton, K.C.M.G., and Major Nathan, C.M.G., Governor of the Gambia and the Gold Coast, to start similar work in Bathurst, and in the principal towns of the latter colony. Consequently, Dr. Everett Dutton, Walter Myers Fellow, was despatched to Bathurst to make a preliminary survey of the subject there—a thing which had not yet been done ; and to start some operations against mosquitoes, with the help of the governor, and of a sum of money from the Sierra Leone fund. As regards the Gold Coast, a handsome sum of money has been specially placed at my disposal by a philantrophical gentleman to pay the salary of a delegate ; and I am happy to be able to state that Dr. Balfour Stewart has accepted the post. Details of these expeditions will be given in later reports.

Anti-Malaria Work Elsewhere

Some of the earliest work against malaria performed on an anti-mosquito basis was that of Young and Thomson at Hong Kong, especially at the military sanatorium, round which the bush was cleared and the breeding places drained.* Similar work has recently been done by Dr. Doty near New York, in connection with an outbreak of malaria in a collection of a hundred houses in Staten Island.† On a large scale, anti-mosquito work seems to have been first commenced a month or two before the operations in Sierra Leone by Major and Surgeon Gorgas in Havana, immediately after the demonstration there of the fact that *Stegomyia* carries yellow fever.‡ Havana contains two hundred and fifty thousand people. In April, Gorgas reports that he has transferred two-thirds of the town cleaning gangs to the mosquito brigades. In May, he says, 'most of our attention is now being paid to the destruction of mosquitoes. The suburbs, and all the small streams in the suburbs, have been pretty thoroughly cleared out ; and the pools oiled and drained. The Mayor has issued an order prohibiting the keeping of standing water anywhere within the city limits, unless made mosquitoproof. This is being enforced ; and all standing water found not protected as required is emptied and the owner fined. We are employing seventy-five men in this mosquito work, and have gotten over the whole city during the last month, and I expect to do this every month during the summer, at any rate as long as it seems to have the present happy result. In this way, during the past month, we have used about

* *British Medical Journal*, 1901, vol. ii, page 683.

† *Boston Medical and Surgical Journal*, 22nd August, 1901 ; and *British Medical Journal*, vol. ii, page 644.

‡ Monthly Reports of Vital Statistics of Havana, Office of Chief Sanitary Officer of Havana.

one thousand four hundred gallons of oil.' The Americans deserve much credit for the commonsense and energy with which they have attacked this question; so different from the hesitation and apathy generally shown by the British.

Regarding the prevention of malaria by other means, we have first the distinguished work of Koch, based on the general use of quinine,* and more recently the no less excellent work of Sir William MacGregor, K.C.M.G., C.B., and of Dr. Strachan at Lagos, based upon quinine, wire gauze to windows and doors, and drainage of marshes.† Much work is said to have been done by the use of wire gauze and quinine in Italy, but I regret that I cannot accept without reserve all the statements made on the subject in that country.

Remarks

It may be advisable to correct some popular errors regarding the operation of clearing mosquitoes. No one has ever supposed it possible to exterminate mosquitoes from whole continents, or even from large rural areas—the operation must be confined principally to towns and their suburbs. No one imagines that it will be possible to exterminate *every* mosquito even from towns—we aim only at reducing their numbers as much as possible. No one supposes that it will be invariably possible to drain or otherwise treat every breeding place of mosquitoes in a town; but even where every place cannot be dealt with, it will always be possible to deal with a very large number; and it often happens that the smallest and most easily drained or emptied puddles or pots breed the greatest number

* *Deutche Medicinische Worchenschrift*, 1899, 1900; and *Journ. of State Medicine*, October, 1901.

† *British Medical Journal*, 1901, vol. ii, pp. 644 and 680

of mosquitoes. Mosquitoes may possibly be carried into towns from a large distance by winds, though I doubt whether there is much or any reliable evidence in favour of this view; but, as a general rule, the vast majority of mosquitoes existing in a town are bred in the streets, yards, gardens, and houses of the town; and if we get rid of these breeding-places, we may calculate on at least greatly reducing the insects in the town. These are the simple principles upon which our efforts are based.

As regards the effect of such measures on mosquito-borne disease, we may expect speedy results in the case of yellow fever, which is not a lingering disease; but in the case of malaria and filariasis, which linger for years after the first infection, good results may not be so immediately manifest. But science assures us that we may continue to work in complete confidence of good results being finally obtained. We know from the experience of ages that drainage abates malaria. And, quite apart from sanitary questions, we shall all admit without argument that the extermination of mosquitoes in tropical towns will constitute one of the greatest possible reforms ever made in life in the tropics.*

(*Signed*) R. ROSS

* I estimate, for several reasons, that the amount of a mosquito-borne disease in a locality should vary roughly as the square of the number of mosquitoes capable of carrying the disease found there. Hence, if the *Anopheles* are reduced to one-half, the malaria should (finally) be reduced to a quarter; if the *Anopheles* are reduced to one-tenth, as should generally be practical, the malaria should be reduced to one-hundredth. But this is an estimate founded merely on *a priori* considerations; and it will always be a matter of great difficulty, especially in native towns, to obtain reliable statistics of the variation of the amount of malaria.

APPENDIX

Letter from C. W. Daniels, Esq., M.B. Cantab.

Note.—*In reading this letter it is necessary to remember that Dr. Daniels inspected the Sierra Leone operations little more than two months after they had been commenced. See also the remarks under the headings,* Progress of the Campaign *and* Results *above*— R. Ross.

1st October, 1901

Dear Ross,

I have carefully examined the various works which have been undertaken with a view to the serious diminution in the number of mosquitoes in Freetown, Sierra Leone. The common mosquitoes found are :—*Anopheles costalis*, the carrier of malaria, and also of *Filaria nocturna*. *Stegomyia fasciata* (*Culex taeniatus*) or brindled mosquito, Calcutta, the mosquito supposed to carry yellow fever.

Two *Culices* (I think, *fatigans*, which carries *Filaria nocturna*, and another which is known both on the East Coast and Shire and Uganda Highlands, but does not attack man) were found, but not commonly.

A. funestus was found near but not in Freetown.

In my opinion, already your efforts have been crowned with a large degree of success, as there has been a noteworthy diminution in the number of the first two genera found in the houses. The number of breeding grounds has been enormously diminished.

The operations, having been only recently begun, are, of course, as yet far from complete. A considerable part of the town, perhaps half, has not been touched. Even in the parts longest under treatment, in the yards

adjoining the streets, there are still numerous breeding grounds ; and in the streets themselves occasional places have either been overlooked or the works undertaken have not been effective as yet.

The breeding places dealt with could be only of importance in the peculiar circumstances of Freetown, *i.e.*, where the soil is impervious and the rainfall excessive (110 in. to 200 in.). Even in Freetown most of them would be destroyed by a week's dry weather, and some by less. As, however, the wet season in Sierra Leone is a prolonged one, for this place these breeding grounds are of great importance, and in dealing with them an excellent beginning has been made.

A great part of the work will not be permanent. The rock cuttings are too narrow, many of them being blocked after each shower. The earth cuttings are also very liable to fall in. This results in much extra work and supervision, as considerable supervision and labour is required, constantly, to keep the work already done in order.

I suggest that during the dry season the rock cuttings should be broadened, so as to be at least three inches at the bottom, the sides being inclined at about 60°. When the rush of water is greater a broader cutting will be requisite.*

The earth cuttings should in all cases have sloping sides where possible, as this minimises the liability to formation of pools, and ensures, even with a small amount of water, a persistent current. There are few things more suitable for *Anopheles* breeding grounds than a drainage system in which the water supply is insufficient to flush the drains.

* Exact uniformity is not essential, but an approximation to it will save a large amount of labour in clearing the channels ; and as this requires to be done very frequently, the point is of importance.

The plan adopted of placing large stones at the edge of the channel, blocked behind by smaller ones, will, I think, suffice if the work is strengthened with cement; but brick drains would be preferable in my opinion, as they are easier to clear.

A large amount of work has been done by filling up rock pools with small broken stones, and, even where the traffic is great, this, when strengthened with cement, will prove to be permanent.

The work is so far incomplete that it is essential that at least one other complete wet season should be spent here. Constant European supervision is necessary, and one man is not sufficient for the purpose. There should be at least two Europeans engaged in supervising; and a larger staff of workmen (quite twice the present) would, I think, be required, as so much of the work will require redoing, and there are other places to deal with.

Towards the foot of Mount Aureole there are in places numerous springs from which the water is constantly running. Pits, usually shallow, have been dug in this district, and in these *Anopheles* larvae are constantly found. Some of them will be difficult to deal with by cuttings alone; and the more permanent should, I think, be converted into covered wells with an overflow underground—say two feet below the surface—leading into a drain to the nearest stream. None of these places have, as yet, been dealt with.

There is one similar place in the Grassfields District, and I feel sure that there are others both near the Wilberforce Barracks and near Kissy. The constant rains and the general waterlogged condition of the ground prevent more definite information being obtainable till there is some continued fine weather. Such places are common, and are the important ones in the hilly districts of Central Africa.

In a few of the wells, which are so numerous in many districts of Sierra Leone, *Anopheles* (*costalis*) larvae were found in numbers. Though I do not think from previous experience that these will at any season in the year be of very great importance, still they are an additional source. In none of the broad public wells which contain fish were larvae found, and on placing a few fish in one of the infested wells the larvae speedily disappeared, but many of the fish died.

Covered wells in any case are safe ; but to so repair the numerous broken-down wells and provide them with covers would be costly and uncertain, as the covers would not be used in many cases.

I am informed that there would be serious difficulty in closing these private wells, and in substituting for them a smaller number of public ones, but that when a good town water supply is obtained much could be done in this direction. Such a water supply, it is expected, will be shortly sanctioned.

Equally dangerous are the numerous pits remaining from disused latrines. Those in use (in many cases overflowing) are dangerous for other reasons, but not as breeding grounds for *Anopheles*.

There are a few deep pools which probably contain water during the greater part of the dry season, and which harbour *Anopheles* larvae ; these require to be filled up.

I notice that some pits are being filled with the mixed assortment of tins and bottles removed from houses. Broken bottles, or others, are well adapted for filling in pits, but the use of tins is to be avoided as the ground will certainly fall in. On these, as on other points, the practical experience of the details gained by Dr. Taylor will be invaluable in the next wet season. Opposite houses, I think, some bridging of gutters

should be done, as otherwise the edges of the gutters are bound to fall in.

As regards the proceedings that will be requisite in the dry season, I can, of course, only theorise from experience elsewhere ; combined with my observation here of the character and lie of the ground.

The evidence seems to be clear that mosquitoes may be expected to be more numerous in the dry season ; because, though of the present breeding grounds few will remain in dry weather, still there will be other breeding places, and these will not be so constantly disturbed or flushed by heavy rains, and, therefore, a large proportion of larvae will reach maturity.

Of the present breeding grounds, there will only remain in the dry season some of the springs, and, perhaps, some of the wells and pools ; the rest of the water will then have dried up. The new places will be mainly the streams, small and large, which remain, possibly some of the other wells, and artificial collections of water in tubs, etc.

Any scheme for destroying these breeding places must take into account* (1) that abundant places must be left for the people to get drinking water ; (2) that places must be left in which the people can wash clothes, etc. These two conditions will prevent any extended application of kerosine or any odorous or poisonous larvicide, and particularly their application to streams, as it is mainly in expanded pools in the course of streams, and not in isolated adjoining pools, that larvae live and proceed to maturity.

The streams are said to contain fish, but, even if they do not, much could not be hoped from stocking

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* When the new water supply is obtained these points will not be essential.

them, as in such situations abundant larvae are often present in the presence of the fish.

Two possible methods which are most obvious are the formation of a central channel in the bed of the stream, with larger collections of water in sufficient numbers of places for drinking purposes, and, lower down the stream, other places for washing, etc.

The second, which might be cheaper but less certainly effective, would be to dam up the streams so as to obtain a sufficient head of water to flush out the whole channel at intervals.

Either scheme would be expensive and would have to be strong, as a rainfall of fifty inches or more in a month of the wet season will destroy any but strong works in the bed of these rocky streams.

I am inclined to think that the number of streams could be reduced, and some of the smaller diverted into the larger channels, and the number of breeding grounds thus diminished. But on these points no positive opinion can be given till the beds have been examined in the dry season.

Though I consider that you have already proved the practicability of exterminating *Anopheles* in Sierra Leone during the wet season, the work is at present incomplete, even in the streets in which most work has been done; and, I estimate, at the present rate of work, will still be incomplete at the end of the wet season, when the work will be entirely changed. During the dry season, in addition to dealing with the new conditions which will then arise, the work already done should be placed on a permanent footing.

In the next wet season double the men, say one hundred, should be employed, and two Europeans for supervision. One European, even so able and energetic a man as Dr. Logan Taylor, barely suffices for thorough supervision of the present work.

I am aware that this will cost, apart from the expense of supervision, over £100 a month instead of the £50 to £60 which, including the cost of labour provided locally, is now spent; but it will be better for one place to be done well, and that a difficult one to deal with, than that partial measures be attempted in many places.

The experiment is being so closely watched and criticized, that failure, or only doubtful success, would be a disaster.

I think, therefore, that it will be more to the true interests of West African hygiene for attention and money to be concentrated on Sierra Leone.*

In this I would make one exception, Sekondi. This new town will, as the terminus of the railway, be one of the most important places on the Coast.

The European work in connection with the railway has not only increased the actual breeding grounds, but by means of trenches *Anopheles* are being conveyed from a distance through the European settlement. No plan seems to be followed in the erection of houses, and, generally speaking, European work already done has complicated matters, and will cause much increased expense in making reasonably healthy what could easily have been from the first a model settlement.†

I think it would be advisable to attempt to obtain in Sierra Leone some numerical estimate of the present prevalence of malaria, and for this purpose suggest as the most convenient the estimation of the proportion of children with splenic enlargement at fixed ages, say between one and two years of age, as, up to two or three years, reliable statements as to the age of children

* There is no fear that our efforts will be abandoned before we have done as much as we conceive it our duty to do.—R. Ross.

† His Excellency, Major Nathan, informed me that he will deal with Sekondi very shortly.—R. Ross.

can generally be obtained. As a check on this method, Barbadians in the West India regiment who have not been previously exposed to malaria, and consequently are highly susceptible, should be examined. In them malarial infection is indicated by malarial fever. The length of residence in Sierra Leone requisite for malarial infection in the Barbadians will then give an indication of the present liability to infection.*

In conclusion, I wish to express my thanks to you personally, and to the Liverpool School of Tropical Medicine, for the opportunity afforded me of seeing the first real British practical application of the principles you have elucidated.

I am

Yours very sincerely

C. W. DANIELS, M.B.

London School of Tropical Medicine

* In order to guard against misapprehensions, it is advisable to state here that we are not now undertaking to prove over again that mosquitoes carry malaria. This fact was fully established long ago. Our present intention is simply to give an object lesson in the manner of ridding tropical towns of mosquitoes by drainage and cleaning up. We are prepared to spend a large sum of money for this purpose; but we are not prepared to continue the work for ever. The work—especially the drainage and collection of rubbish—properly belongs to the local authorities. If they choose to continue our efforts, then we can confidently promise that the mosquito-borne disease in Freetown will be, ultimately, very materially reduced. If, however, they discontinue them—if they allow the town to sink back into the condition it was in when we arrived—then I can only say that the mosquito-borne disease will remain. It is for them to choose. I may add, however, that I have no doubt that the former course will be the one adopted.

R. Ross

Publications of the Liverpool School of Tropical Medicine

MEMOIR I

Instructions for the Prevention of Malarial Fever, for the use of Residents in Malarious Places. Giving a short account of the disease and the modes of prevention. 8oooth. Price 2s. 8°. University Press of Liverpool.

New and much enlarged edition, by Major R. Ross, F.R.C.S., D.P.H., F.R.S., Walter Myers Lecturer in Tropical Medicine—*Forthcoming*.

MEMOIR II

Report of the Malaria Expedition (to Sierra Leone, 1899). By Ronald Ross, D.P.H., M.R.C.S., H. E. Annett, M.B., D.P.H., and E. E. Austen. Being a full account of the first expedition of the School, and containing besides much matter relating to the parasites of malaria, to the gnats which carry them, and embodying some previous observations of Major Ross in India. Illustrated by four maps and five full-page collotypes. Quarto. Price 10s. 6d. University Press of Liverpool.

Note.—As only a few copies of this important work remain, and as the plates cannot be renewed, the price of the remaining copies has been raised to two guineas.

MEMOIR III

Report of the Malaria Expedition to Nigeria (1900), by H. E. Annett, M.D., D.P.H., J. Everett Dutton, M.B., B.Ch., and J. H. Elliott, M.D. Part I. *Malarial Fever*, etc. Giving a full account of the expedition, with numerous views in the texts, charts, maps and two plates, and containing much matter of general importance. Quarto. Price 7s. 6d. University Press of Liverpool.

MEMOIR IV

Report of the Malaria Expedition to Nigeria, by the same authors. Part II. *Filariasis*. Containing many new observations upon Filariae of Birds, with numerous illustrations and nineteen plates, five of which are coloured and give the microscopical anatomy of the head of *Anopheles costalis* (by Dr. Dutton). Quarto. Price 10s. 6d. University Press of Liverpool.

MEMOIR V, PART 1

First Progress Report of the Campaign against Mosquitoes in Sierra Leone, by Major R. Ross, F.R.C.S., D.P.H., F.R.S., dated 15th October, 1901, giving details of the commencement of the Campaign, with a letter from Dr. DANIELS regarding the results arrived at to date. 8°. Price 1s. University Press of Liverpool.

NOTE.—Succeeding parts of this Memoir will contain descriptions of the further progress of the campaign in Sierra Leone and elsewhere.

MEMOIR VI

Mosquito Brigades, and How to Organize Them, by Major R. Ross, F.R.C.S., D.P.H., F.R.S., containing full details regarding the mode of starting a campaign against mosquitoes, how to conduct the work, and where to attempt it; with other matter relating to the subject. 8°. Price 3s. George Philip & Son, 32 Fleet Street, London; and

GRATIS, on application to the School,

Malaria and Mosquitoes. A discourse delivered at the Royal Institution of Great Britain by Major R. Ross, D.P.H., M.R.C.S., 1900 (by permission of the Institution), giving a full history of the solution of the malaria problem.

All of the above, except Memoir VI, to be had from the Thompson Yates Laboratory, University College, Liverpool.

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